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FULL-TREE SKIDDING FAVORS BLACK SPRUCE REPRODUCTION UNDER CERTAIN PEATLAND CONDITIONS

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ABSTRACT.—Two trials on different sites indicate that clearcut black spruce reproduces well after full-tree skidding only on nonbrushy sites that have fairly abundant sphagnum seedbeds and adequate natural seeding.

OXFORD: 231.3:375.4:174.7(776) *Picea mariana.*
KEY WORDS: *Picea mariana,* mechanized harvesting, site preparation, natural seeding, broadcast burning, Minnesota.

Because of increased mechanization, full-tree skidding has become a popular way to harvest black spruce (*Picea mariana* (Mill.) B. S. P.) on the extensive peatlands of north-central Minnesota. However, compared with broadcast burning, little is known about full-tree skidding as a method of site preparation for reproducing clearcut black spruce by natural seeding. Findings have been reported for only one trial 2 years after skidding (Johnston 1975), plus two other studies where piling of slash simulated full-tree skidding by keeping seedbeds exposed (Johnston 1971, Verry and Elling 1978). Further, this research was done only on **nonbrushy** sites that had **abundant** sphagnum moss (*Sphagnum* spp.)—a good seedbed. So even though actual or simulated skidding resulted in satisfactory reproduction under these conditions, no findings have been reported to guide forest managers dealing with other conditions.

However, 2-year results are now available from a trial of full-tree skidding on a **brushy** site that had **sparse** sphagnum seedbeds. And 7-year results are available from the previous skidding trial mentioned above. The overall results from these two trials indicate that at present full-tree skidding is reliable for reproducing black spruce only on nonbrushy sites that have fairly abundant sphagnum seedbeds and adequate natural seeding.

PROCEDURE

The trials were made in mature stands of black spruce on separate peatlands near Big Falls in north-central Minnesota.[1] The **brushy** site, which apparently receives nutrient-enriched soil water from an adjacent upland, represents good site quality for black spruce growing on organic soil. The stand was low density (at least partly because of wind-caused mortality), had trees such as balsam fir (*Abies balsamea* (L.) Mill.) and paper birch (*Betula papyrifera* Marsh.), tall shrubs such as speckled alder (*Alnus rugosa* (Du Roi) Spreng.), and sparse sphagnum seedbeds. The **nonbrushy** site, which represents medium site quality, had a dense stand of pure black spruce, no tall shrubs, and abundant sphagnum seedbeds.

Harvesting was done in winter when the ground was frozen. The brushy site was harvested the same way as the nonbrushy site (Johnston 1975): trees 2

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inches d.b.h. and larger were felled; those 3 inches d.b.h. and larger were pulled to a landing as whole trees by a rubber-tired skidder, and then processed. Felling and skidding were done with reasonable care to minimize breaking off branches and tops. The harvest averaged 16 and 26 cords of conifer pulpwood per acre on the brushy site and nonbrushy site, respectively.

Natural seeding was provided by a mature stand of black spruce that bordered the brushy site (230 by 730 feet) on the long, windward side and the nonbrushy site (330 by 530 feet) on three sides. Although the brushy site's seed source averaged only 40 square feet of basal area per acre for spruce trees more than 3.5 inches d.b.h., seeding was considered adequate because a similar site nearby with a similar seed source reproduced satisfactorily after broadcast burning. The brushy site was sampled the same way as the nonbrushy site (Johnston 1975): tree reproduction was counted on a ¼-milacre subplot in 100 well-distributed milacre plots 2 years after skidding; if black spruce was absent on the subplot, its presence was checked on the whole plot to determine milacre stocking. Also, seedbeds were recorded by cover class on the 100 ¼-milacre subplots to help explain reproduction results.

The nonbrushy site, which continued to receive natural seeding, was resampled 7 years after skidding to find out if the reproduction had changed substantially since 2 years after skidding. Data were obtained from the previously established 100 subplots and plots as described above. In addition, the height of the tallest black spruce and quaking aspen (*Populus tremuloides* Michx.) was measured on these subplots to determine to what extent spruce was overtopped by the aspen that seeded in.

RESULTS AND DISCUSSION

Black spruce seedlings averaged 800 per acre and 39 percent milacre stocking on the brushy site 2 years after full-tree skidding. These values are very low compared with the several thousand seedlings per acre and more than 80 or 90 percent stocking reported earlier for the nonbrushy site 2 years after skidding and for brushy and nonbrushy sites 2 to 4 years after broadcast burning (table 1). Probably the main reason black spruce reproduced poorly on the brushy site after skidding is because sphagnum moss, which usually remains moist after exposure, was sparse. Sphagnum seedbeds covered more than one-fourth of the ground on only 2 percent of the ¼-milacre subplots on the brushy site compared with 64 percent on the nonbrushy site.

Because little snow covered the brushy site during skidding, a substantial amount of scarified and compacted seedbeds resulted. At first it appeared these nonsphagnum seedbeds would compensate for the shortage of sphagnum seedbeds, but the results show they did not. A long dry period the first summer probably caused considerable seedling mortality, especially on these nonsphagnum seedbeds. However, initial establishment should have been good the second summer had sphagnum seedbeds been abundant.

Associated reproduction was composed mainly of quaking aspen and paper birch on the brushy site 2 years after full-tree skidding, as on the nonbrushy site. However, these two species plus black ash (*Fraxinus nigra* Marsh.) and balsam fir were considerably more abundant on the brushy site (table 2). Further, whereas all stems on the nonbrushy site were new seedlings and less than 2 feet tall, on the brushy site 39 percent of the birch and nearly all of the ash were

Table 1.—*Black spruce seedlings after full-tree skidding or broadcast burning on brushy and nonbrushy sites receiving natural seeding*[1]

Treatment	Site	Time after treatment	Seedlings[2]		Basis: areas sampled
			Stems per acre	Milacre stocking	
		Years	*Number*	*Percent*	*Number*
Full-tree skidding	Brushy	2	800	39	1
	Nonbrushy	2	22,600	92	1
		7	22,800	96	
Broadcast burning	Brushy	2-3	8,100	84	2
	Nonbrushy	2-4	17,600	98	2

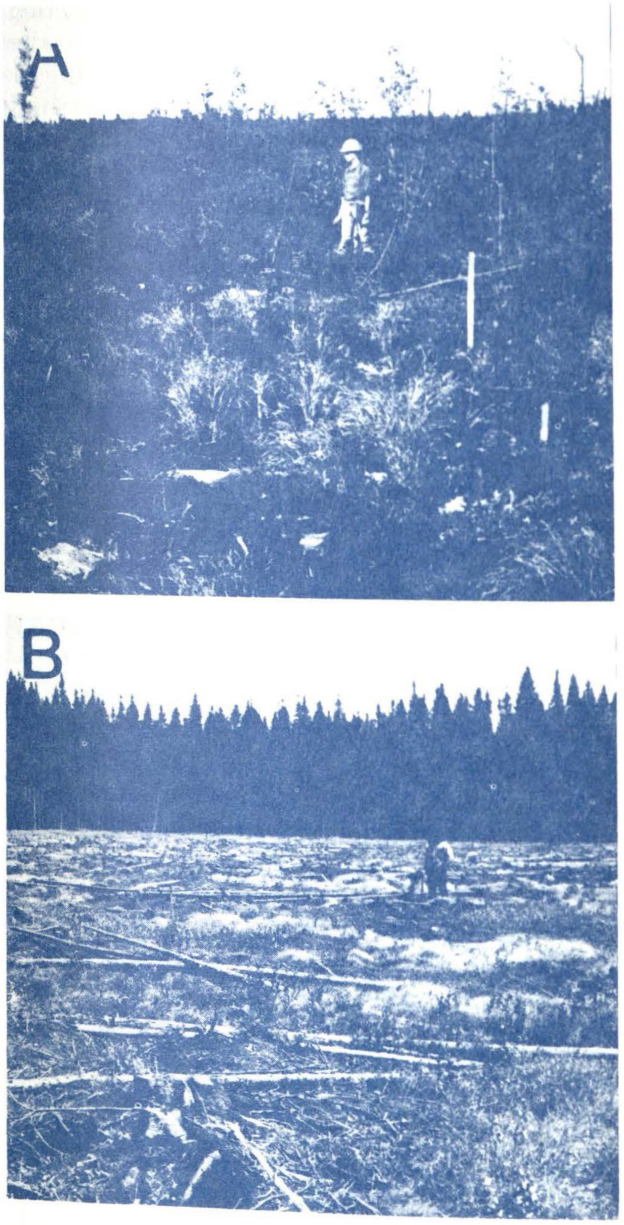
[1]Values in second row from Johnston 1975; those in last two rows adapted from Johnston 1971.

[2]Advance growth almost nil, so excluded.

Table 2.—*Associated reproduction after full-tree skidding on the brushy site and nonbrushy site*

Site	Time after treatment	Species			
		Quaking aspen	Paper birch	Black ash	Balsam fir
	Years	*Number of stems per acre*			
Brushy	2	17,900	6,600	900	700
Nonbrushy	2	4,900	800	0	<100
	7	4,300	5,400	0	200

sprouts, 58 percent of the fir were advance seedlings, and 1,100 stems per acre— mainly birch—were 2 to 7 feet tall. Finally, other vegetation such as grasses, sedges, and shrubs was much denser on the brushy site than nonbrushy site 2 years after skidding (fig. 1, A and B).



Thus black spruce seedlings were not only relatively scarce on the brushy site 2 years after full-tree skidding, but they also had much more vegetation to compete with than on the nonbrushy site. In addition, this vegetation produced a large amount of leaf litter—a poor seedbed. Leaf litter seedbeds covered more than one-fourth of the ground on about 80 percent of the ¼-milacre subplots on the brushy site compared with only 1 percent on the nonbrushy site. So even with continued natural seeding, satisfactory reproduction of black spruce—at least 60 percent milacre stocking of **established** seedlings (Johnston 1977)—either will not be obtained on the brushy site or will require several more years.

Black spruce reproduction on the nonbrushy site 7 years after full-tree skidding was almost identical to that reported earlier for 2 years—about 23,000 seedlings per acre and more than 90 percent milacre stocking (table 1). The number of quaking aspen and balsam fir seedlings also changed little, whereas paper birch seedlings were much more abundant at 7

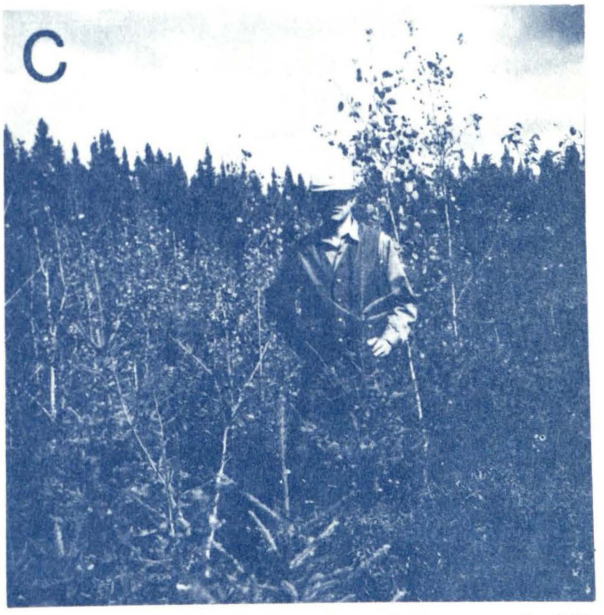


Figure 1.—*Trial areas after full-tree skidding: brushy site at 2 years (A), nonbrushy site at 2 years (B) and 7 years (C).*

years than at 2 years (table 2). Although birch may have increased some from further seeding, most stems were likely present at 2 years but too small to be readily identified. Practically no more reproduction became established on the nonbrushy site despite 5 more years of natural seeding because the high number of black spruce and associated seedlings 2 years after skidding probably already occupied the good seedbeds.

The tallest black spruces on the nonbrushy site 7 years after skidding averaged less than half the height of the tallest quaking aspens—2.4 vs. 5.2 feet. However, spruce was generally growing well and many stems were not overtopped by aspen or birch (fig. 1, C). Thus release probably will not increase the growth of black spruce much on this medium quality site, but a trial is under way.

MANAGEMENT IMPLICATIONS

Sound information is still limited on using full-tree skidding as a method of site preparation for reproducing clearcut black spruce by natural seeding. However, research and experience to date indicate that spruce seedlings will have the following relative stocking about 5 years after skidding under the peatland conditions shown:

	Sphagnum seedbeds	
Site	**Abundant**	**Sparse**
Nonbrushy	Good to overstocked	Understocked to poor
Brushy	Poor to moderate	Understocked to poor

The two trials reported in this note represent two of the conditions in the above tabulation. The nonbrushy site with abundant sphagnum had good seedbeds plus little competing vegetation, and so was overstocked—more than 10,000 spruce seedlings per acre (Johnston 1977). In contrast, the brushy site with sparse sphagnum had poor seedbeds plus much competing vegetation, and so was understocked—less than 60 percent milacre stocking.

Full-tree skidding has not been tried under the other two conditions in the preceding tabulation. Nevertheless, brushy sites with abundant sphagnum should have ample black spruce seedlings initially because of good seedbeds, but much competing vegetation is expected. So unless these seedlings are released, their stocking will likely be poor to moderate after a few years. Full-tree skidding on nonbrushy sites with sparse sphagnum probably will result in poor stocking at best. This is because other mosses, particularly the feather mosses, usually dry up after clearcutting and become poor seedbeds (Johnston 1971, 1977).

Therefore, until further information is available, full-tree skidding is recommended for reproducing black spruce only on nonbrushy sites that have fairly abundant sphagnum seedbeds and adequate natural seeding. Exposed patches of sphagnum should have a milacre stocking of 60 percent or more, and seed should be provided by a mature spruce stand within 130 to 260 feet of the skidded area (Johnston 1977).

Broadcast burning of slash is still recommended for most other peatland conditions (Johnston 1977). In fact, severe burning is the only reliable practice at present to initially control competing vegetation on brushy sites and to improve nonsphagnum seedbeds. However, the popularity of full-tree skidding black spruce means few loggers are any longer willing to remove just the pulpwood and leave the slash evenly distributed for burning. Hence alternative practices such as planting or mechanical preparation of seedbeds need to be developed for those conditions where skidding alone will not result in satisfactory reproduction.

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